National Aeronautics and Space Administration
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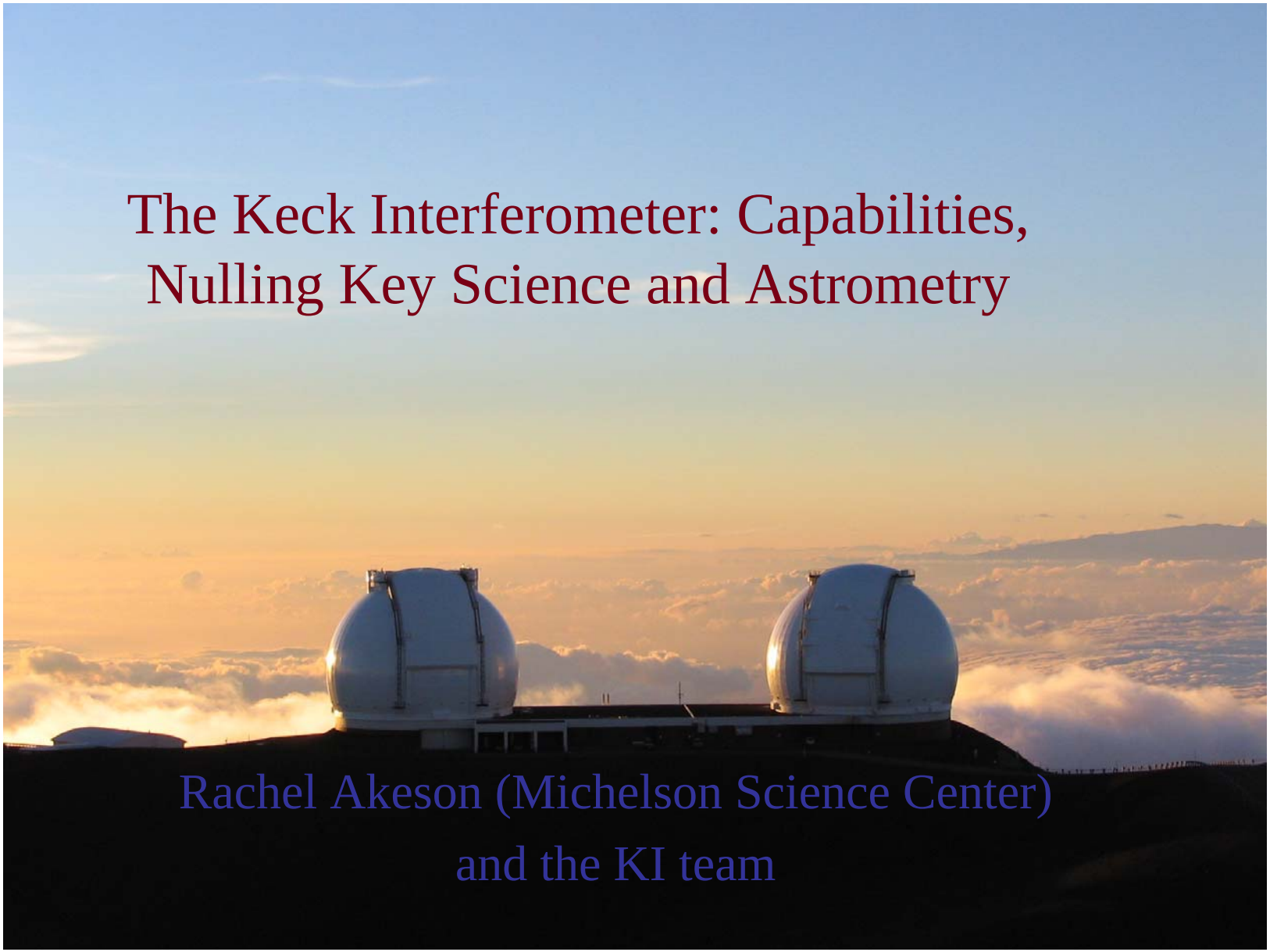
MSC Michelson Science Center

# The Keck Interferometer: Capabilities, Nulling Key Science and Astrometry



Rachel Akeson (Michelson Science Center)
and the KI team

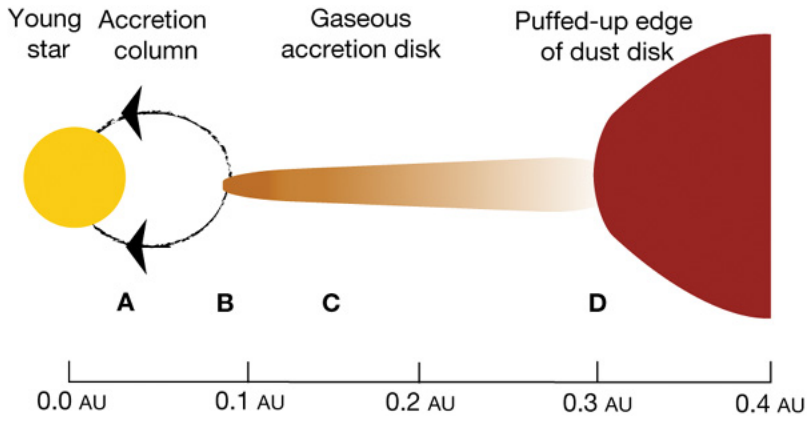
# The Keck Interferometer



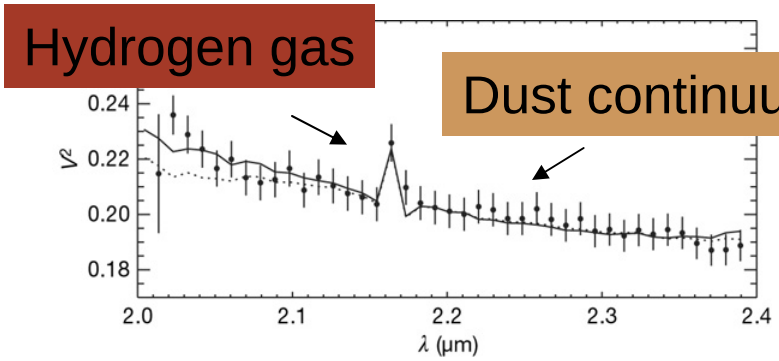
- The Keck Interferometer (KI) was jointly developed by JPL, the Michelson Science Center and the W.M. Keck Observatory
  - KI combines the two 10-meter Keck telescopes on an 85 meter baseline
  - Adaptive optics used on both telescopes
  - 1.6 and 2.2 μm active fringe tracking
  - 10 μm nulling mode
- Operational since 2004, KI is open to all US-based investigators through the NASA proposal process
  - 5 milliarcsec fringe spacing
  - Sensitivity limits: Visible < 12 mag and 2 μm < 10 mag
  - Medium resolution (R~200) mode available
  - KI is currently the most sensitive near-infrared, long-baseline interferometer in the world
  - KI data are available to the public through the MSC archive

# Science Highlights (1)

- KI has observed a range of objects, including disks around young stars, novae and active galactic nuclei
- In the study of circumstellar disks around young stars, KI has made substantial contributions
  - Goal is to characterize the structure and evolution of the disk, which provides the material for planet formation
  - Angular resolution corresponds to <1 AU in nearby young stars
  - Determined the inner dust radius for young analogs of our Sun
  - Medium resolution mode probes the gas distribution



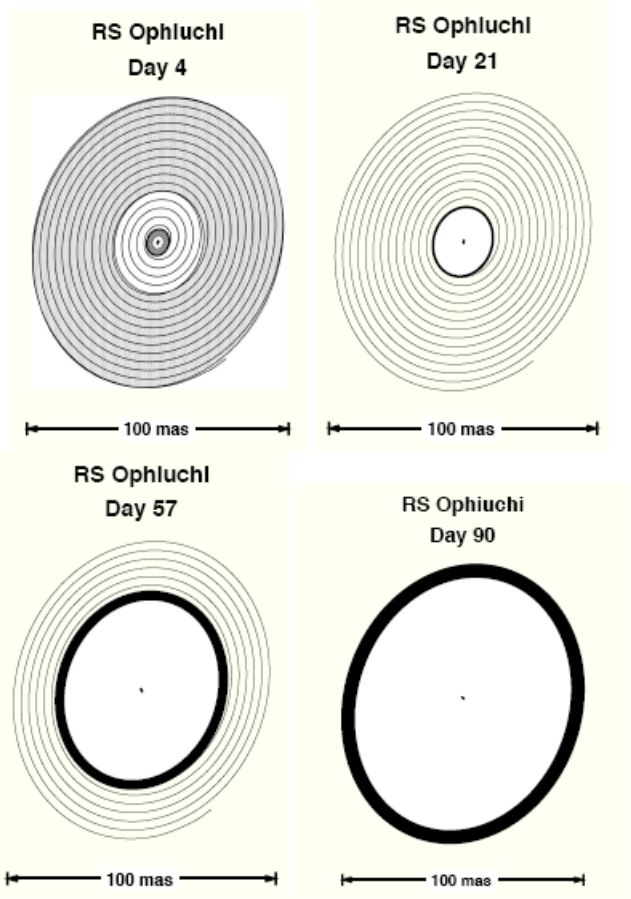

Eisner (2007), Nature



# Science Highlights (2)



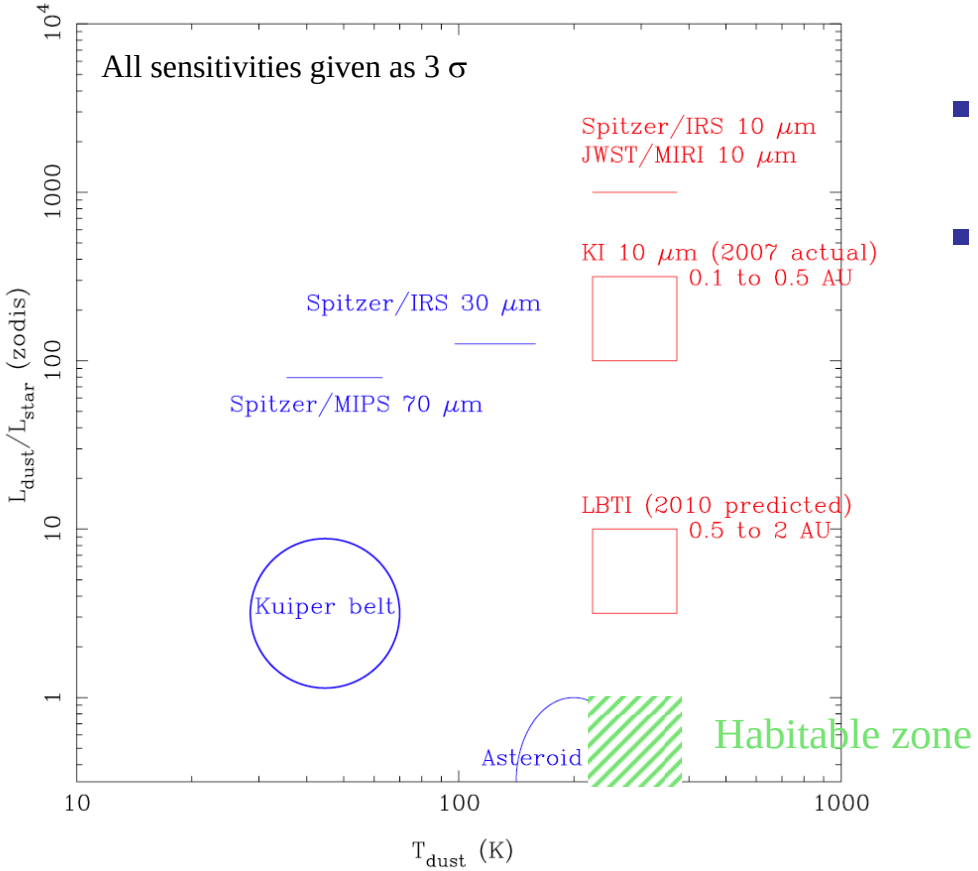
- The 10 μm nulling mode was used to observe the recurrent nova RS Oph (Barry et al, 2008)
  - The spectral resolution of the nuller data reveal differences in dust composition from 25 to 200 milliarcsecs
  - Modelled as mass transfer from the secondary star (red giant) onto the white dwarf with an increase in density due to a spiral shock wave through the red giant wind



# Nulling Key Science Survey



- The KI Nuller was developed to survey nearby stars for exo-zodiacal dust.
  - Three teams were selected to conduct this survey, which will observe 45 stars over the next year.



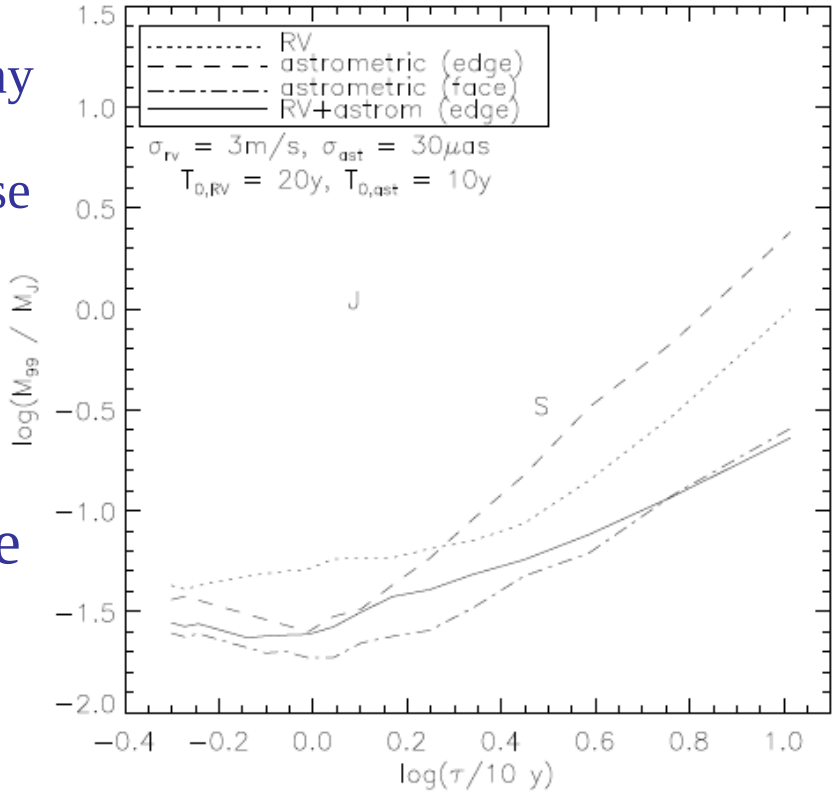

- KI observations will spatially constrain the excess
- For a G2V star the sensitivity in a 3-hour block corresponds to a limit of $L_{dust}/L_{star} = 3x10^{-5}$ (3 σ) or ~300 times our solar system's zodiacal cloud.

# New modes: Astrometry



- ASTRA is an NSF-funded project to add phase-referencing and astrometry to KI
- With a precision of 30-100 μ-arcsec, the astrometry mode will
  - measure the true mass of many known radial velocity planets
  - search for new planets in those systems
  - search for planets around young stars which are too active for precise radial velocity observations
- The phase-referencing mode will increase the sensitivity limit to K<14 and allow resolutions of R>1000

Detection space for astrometry



# For more on KI

- KI nulling design and implementation: Colavita talk/poster
- KI nulling science: Serabyn talk/poster
- Circumstellar disks with infrared interferometry (including KI): Millan-Gabet poster
- Proposal and data support:
  - http://msc.caltech.edu/software/KISupport/